

HOST PLANTS FOR NORTH AMERICAN SPECIES OF *RIVELLIA* (DIPTERA: PLATYSTOMATIDAE)¹

B.A. Foote, B.D. Bowker, B.A. McMichael²

ABSTRACT: Host plants for 11 of the 31 Nearctic species of *Rivellia* represent 6 species of Leguminosae belonging to 5 genera of the subfamily Papilionoideae. Larvae attack and destroy root nodules and may reduce the nitrogen-fixing capability of the host plant.

The recent discovery that *Rivellia quadrfasciata* (Macquart) has shifted from its native legume host to soybean in Louisiana (Eastman and Wuensche 1977) and North Carolina (Koethe 1982) has stimulated interest in this genus of the largely tropical family Platystomatidae. Newsom et al. (1978) have shown that larval feeding on soybean root nodules by *R. quadrfasciata* can affect the nitrogen-fixing capacity of the plant. Koethe and Van Duyn (1984) have discussed larval feeding behavior on soybean nodules and reported that southern pea (*Vigna unguiculata* (L.) Walp.) was also being attacked by larvae. Later, Koethe and Van Duyn (1986) described the oviposition behavior of this species, and Koethe et al. (1986) discussed its adult seasonality and overwintering habits. Foote (1985) elucidated the life cycle of *R. pallida* Loew, a species associated with hog-peanut (*Amphicarpaea bracteata* (L.) Fernald) in the Eastern States. He also listed the known host plants of the Nearctic species of *Rivellia*, and predicted that several other species of the genus will eventually shift to a variety of introduced, agriculturally important species of Leguminosae. Bibro and Foote (1986) described and illustrated the mature larva of *R. pallida*, utilizing a scanning electron microscope.

The present paper is an expansion of the host plant list published by Foote (1985) and includes natural history observations on several species.

MATERIALS AND METHODS

Most of the field work on potential legume hosts of *Rivellia* was carried out in northeastern Ohio between 1981 and 1986, with occasional trips to sites in the more southeastern counties of the state. Other observations were made during a week-long collecting trip to Missouri, Oklahoma, and Kansas during early May, 1985, and additional records were obtained in eastern Oklahoma on May 23, 1986. Suspected host plants were swept with a standard insect net. A legume species was considered to be a host

¹Received Jan. 9, 1987. Accepted March 23, 1987.

²Department of Biological Sciences, Kent State University Kent, OH 44242.

only if at least 2 separate stands of the plant produced adult *Rivellia*. In addition to sweeping, soil samples taken below suspected hosts were examined for immature stages. Larvae and puparia were subsequently reared to the adult stage to obtain species identifications. Larvae were provided with root nodules taken from the host plant. Voucher specimens of the host plants and species of *Rivellia* have been deposited in the research collection of Kent State University.

RESULTS AND DISCUSSION

Six species of Leguminosae representing 5 genera of the subfamily Papilionoideae are now known to serve as hosts for *Rivellia* larvae (Table 1). Observations on each of the *Rivellia* sp. are given in the following section.

The few adults of *R. flavimana* Loew and *R. metallica* Wulp that we have collected were all swept from stands of hog-peanut in northeastern Ohio during mid to late June. One fully grown larva of the former species was encountered in a soil sample taken beneath the host plant on October 5, 1985. Because no pupation had occurred during the 35 days that the larva was held at room temperatures, it was transferred to a refrigerator on November 10 where it remained until April 9, 1986. On that date the larva was returned to room temperatures. It formed a puparium on April 13, with an adult male emerging on April 21. Interestingly, 11 other larvae found in the same soil sample on October 5 all produced adults of *R. pallida*. Namba (1956) encountered adults of all 3 species on hog-peanut in Minnesota.

Both *R. melliginis* (Fitch) and *R. viridulans* Robineau-Desvoidy were swept from black locust (*Robinia pseudoacacia* L.) at numerous localities in Ohio and at one site in western Missouri between early May and late July, with most of the records being obtained in June. Collecting data indicate that *R. melliginis* was, by far, the more abundant species. However, eggs, larvae, and puparia of both species were recovered from soil collected below stands of *Robinia*. At least 2 generations a year are produced in northeastern Ohio, with overwintering occurring as mature larvae in diapause.

The first record of the host plant for *R. micans* Loew was obtained on May 13, 1985, when 5 adults of both sexes were swept from false-indigo (*Amorpha fruticosa* L.) growing on the shoreline of the reservoir at the Great Salt Plains State Park in northcentral Oklahoma. On July 12, 1986, a second collection of some 30 adults was swept from a single specimen of false-indigo growing on the north shore of the Ohio River 20 miles east of Marietta, Ohio. In Oklahoma, this species was associated with adults of *R. munda* Namba, but it occurred alone at the Ohio River site.

Information on the host plant of *R. munda* was first obtained on May 13, 1985, when 31 adults were swept from *A. fruticosa* at the Great Salt Plains State Park, Oklahoma. A second collection was taken from *Amorpha* growing on the shore of Eufaula Lake in eastern Oklahoma on May 23, 1986. Surprisingly, *R. munda* was not taken from *Amorpha* in southern Ohio during July, 1986, although *R. micans* was collected abundantly there.

The natural history and basic ecology of *R. quadrifasciata*, the soybean nodule fly, is now well studied, as it has become an economic pest of soybean and southern pea. Harold Lambert (personal communication) reported that the native host of *R. quadrifasciata* in Louisiana probably is a species of tick trefoil (*Desmodium* sp.).

Immature stages and adults of *R. steyskali* Namba were repeatedly collected in stands of *Desmodium paniculatum* (L.) DC. in northern and southern Ohio. At least 2, possibly 3, generations a year occur in the northeastern part of the state, with overwintering taking place as mature larvae in diapause.

The first record of the host plant of *R. variabilis* Loew was obtained at Kent, Ohio, on May 5, 1986, when a male and female of the black form (Namba 1956) emerged from puparia that had been formed by larvae encountered in soil samples taken below vines of ground-nut (*Apios americana* Medic.) in late November, 1985. The larvae were refrigerated for 150 days before being returned to room temperatures. Two adults were later swept from scattered individuals of ground-nut at the Herrick Fen Nature Preserve in Portage County, Ohio, on July 27, 1986. Interestingly, adults and immature stages of a second species, *R. winifredae* Namba, have also been recorded from ground-nut (Foote 1985).

The available evidence strongly suggests that all Nearctic species of *Rivellia* are restricted to various species of Leguminosae for their larval nutrition. Apparently this is true also in other regions of the world. Koizumi (1957) and Bhattacharjee (1977) found *Rivellia* larvae attacking root nodules of soybean in Japan and India, respectively. Seeger and Maldaque (1960) reported that an undetermined species of *Rivellia* was an important enemy of peanut, *Arachis hypogea* L., in equatorial Africa. Finally, Diatloff (1965) stated that *Rivellia* larvae were consuming root nodules of a pasture legume, (*Glycine javanica* L.) in Australia.

It may be significant that all known hosts of the Nearctic species of *Rivellia* belong to the legume subfamily Papilionoideae. No adults were obtained in repeated sweeping of honey locust (*Gleditsia triacanthos* L.) and redbud (*Cercis canadensis* L.), both of the subfamily Caesalpinoideae, in Ohio. Similarly, no adults were taken from prairie clover (*Desmanthus illinoensis* (Michx.) MacM.) or sensitive brier (*Schrankia nuttallii* (DC.) Standl.), of the Mimosoideae, in Missouri and Oklahoma. Species belonging

to the Caesalpinioideae generally do not produce root nodules, although several taxa of Mimosoideae are well nodulated (Allen and Allen 1981). Unfortunately, most of the agriculturally important species of Leguminosae belong to the very large, widespread, and well nodulated subfamily Papilionoideae. The recent reports that larvae of *R. quadrifasciata* have shifted to southern pea (Koethe and Van Duyn 1984) and soybean (Eastman and Wuensche 1977) supports the suggestion (Foote 1985) that additional species of the genus will eventually shift to introduced legume crops that are now widely planted in North America.

Table 1. Native Host Plants of North American *Rivellia*.

Species of <i>Rivellia</i> .	Host Plant	Study Site
<i>R. flavimana</i>	<i>Amphicarpaea bracteata</i>	OH, MN
<i>R. melliginis</i>	<i>Robinia pseudoacacia</i>	MO, OH
<i>R. metallica</i>	<i>Amphicarpaea bracteata</i>	OH, MN
<i>R. micans</i>	<i>Amorpha fruticosa</i>	OH, OK
<i>R. munda</i>	<i>Amorpha fruticosa</i>	OK
<i>R. pallida</i>	<i>Amphicarpaea bracteata</i>	OH, MN
<i>R. quadrifasciata</i>	<i>Desmodium</i> sp.?	LA, NC
<i>R. steyskali</i>	<i>Desmodium paniculatum</i>	OH
<i>R. variabilis</i>	<i>Apios americana</i>	OH
<i>R. viridulans</i>	<i>Robinia pseudoacacia</i>	OH
<i>R. winifredae</i>	<i>Apios americana</i>	OH, MN

ACKNOWLEDGMENTS

We are indebted to Barbara Andreas, Cuyahoga Community College in Cleveland, for taxonomic aid in determining species of Leguminosae. Harold Lambert, Department of Entomology at Louisiana State University, provided information on the native host of the soybean nodule fly, *Rivellia quadrifasciata*.

LITERATURE CITED

- Allen, O.N., and E.K. Allen. 1981. The Leguminosae. Univ. Wisc. Press, Madison. lxiv+812p.
- Bhattacharjee, N.S. 1977. Preliminary studies on the effect of some soil insecticides on soybean nodulation. Pesticides 11: 38.
- Bibro, C.M., and B.A. Foote. 1986. Larval description of *Rivellia pallida* (Diptera: Platystomatidae), a consumer of the nitrogen-fixing root nodules of hog-peanut, *Amphicarpa bracteata* (Leguminosae). Proc. Entomol. Soc. Wash. 88: 578-584.
- Diatloff, A. 1965. Larvae of *Rivellia* (Diptera: Platystomatidae) attacking the root nodules of *Glycine javanica* L. J. Entomol. Soc. Queensland 4: 86.
- Eastman, C.E., and A.L. Wuensche. 1977. A new insect damaging nodules of soybean: *Rivellia quadrifasciata* (Macquart). J. Ga. Entomol. Soc. 12: 190-199.
- Foote, B.A. 1985. Biology of *Rivellia pallida* (Diptera: Platystomatidae), a consumer of the nitrogen-fixing root nodules of *Amphicarpa bracteata* (Leguminosae). J. Kansas Entomol. Soc. 58: 27-35.

- Koethe, R.W. 1982. Descriptive studies of the biology and ecology of *Rivellia quadrifasciata* (Macquart) in eastern North Carolina. Ph. D. Diss., North Carolina St. Univ. 144p.
- Koethe, R.V. and J.W. Van Duyn. 1984. Aspects of larva/host relations of the soybean nodule fly, *Rivellia quadrifasciata* (Diptera: Platystomatidae). Environ. Entomol. 13: 945-947.
- Koethe, R.W. and J.W. Van Duyn. 1986. A technique for studying oviposition of the soybean nodule fly, *Rivellia quadrifasciata*. J. Agr. Entomol. 2: 383-387.
- Koethe, R.W., F. Gould, and J.W. Van Duyn. 1986. Soybean nodule fly, *Rivellia quadrifasciata* (Diptera: Platystomatidae): Aspects of overwintering and adult seasonal abundance. Environ. Entomol. 15: 349-354.
- Koizumi, K. 1957. Notes on dipterous pests of economic plants in Japan. Botyu-Kagaki 22: 223-227.
- Namba, R. 1956. A revision of the flies of the genus *Rivellia* (Otitidae, Diptera) of America north of Mexico. U.S. Nat. Mus. Proc. 106: 21-84.
- Newsom, L.D., E.P. Dunigan, C.E. Eastman, R.L. Hutchison, and R.M. McPherson. 1978. Insect injury reduces nitrogen fixation in soybeans. La. Agric. 21: 15-16.
- Seeger, J.R., and M.E. Maldague. 1960. Infestation de nodules de legumineuses en region equatoriale par des larves de *Rivellia* sp. (Dipt.). Parasitica 16: 75-84.
-
-

XVIII INTERNATIONAL CONGRESS OF ENTOMOLOGY

Vancouver, Brit. Col., Canada
July 3-9, 1988

Sponsored by the Entomological Society of Canada, Facilities will be provided by, and all scientific sessions will be held on the campus of, the Univ. of British Columbia.

Scientific program will include plenary lectures and symposia, section symposia, workshops, and special-interest group meetings, as well as contributed paper and poster sessions. Entomologists wishing to propose sectional symposia, special-interest group meetings, or workshops should write to Dr. G.G.E. Scudder (see below).

Persons wishing to receive the Second Announcement Brochure containing details of program, registration, accommodation, tours, etc. should write to Dr. G.G.E. Scudder, Secretary-General, XVIII International Congress of Entomology, Dep't of Zoology, Univ. of British Columbia, Vancouver B.C. V6T 2A9, Canada.